PATENT COOPERATION TREATY

PCT

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference ZCO-115PC	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/US2007/008046	International filing date *(day/month/year)* 03 April 2007 (03.04.2007)	Priority date *(day/month/year)* 06 April 2006 (06.04.2006)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant Z CORPORATION		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 14 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☒	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☒	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 08 October 2008 (08.10.2008)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Athina Nickitas-Etienne e-mail: pt04.pct@wipo.int

Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2007/008046	03.04.2007	06.04.2006

International Patent Classification (IPC) or both national classification and IPC
INV. B29C67/00
ADD. B29K101/10 B29K105/16

Applicant
Z CORPORATION

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	see form PCT/ISA/210	Pierre, Nathalie Telephone No. +31 70 340-2837

Form (PCT/ISA/237) (Cover Sheet) (April 2005)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2007/008046

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

      ☐ a sequence listing

      ☐ table(s) related to the sequence listing

   b. format of material:

      ☐ on paper

      ☐ in electronic form

   c. time of filing/furnishing:

      ☐ contained in the international application as filed.

      ☐ filed together with the international application in electronic form.

      ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has, within the applicable time limit:

   ☒ paid additional fees

   ☐ paid additional fees under protest and, where applicable, the protest fee

   ☐ paid additional fees under protest but the applicable protest fee was not paid

   ☐ not paid additional fees

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with

   ☒ not complied with for the following reasons:

   see separate sheet

4. Consequently, this report has been established in respect of the following parts of the international application:

   ☒ all parts.

   ☐ the parts relating to claims Nos.

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	26, 27, 30, 32-51
	No:	Claims	1-23, 24, 25, 28, 29, 31
Inventive step (IS)	Yes:	Claims	34-41,43-51
	No:	Claims	1-33, 42
Industrial applicability (IA)	Yes:	Claims	1-51
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item IV

Lack of unity of invention

1. Reference is made to the following document:

   D1: WO 2005/090055 A (DEGUSSA [DE]; MONSHEIMER SYLVIA [DE]; GREBE MAIK [DE]; GOERING RAINER) 29 September 2005 (2005-09-29)

2. The present application relates to several inventions or groups of inventions which are not so linked as to form a single general inventive concept and therefore do not comply with the requirements of PCT Rule 13.1, the different inventions being the following:

   Invention 1 - Claims 1-23:
   Material system for 3D-printing wherein a static and a dynamic friction coefficient of the granular material possess a relationship defined by a Bredt parameter having a value in excess of 0.1.
   Invention 2 - Claims 24-41:
   3D-printing methods using sources of energy different from a focused laser beam.
   Invention 3 - Claims 42 and 43-51:
   Machine and material system for 3D-printing comprising temperature control means.

3. The only features common to the 3 inventions are conventional features of 3D-printing wherein a particulate material on which a material with specific properties (absorber, reactant) is printed.
   These features are well known from the prior art, as disclosed by document Do (see p. 9, l. 27 to p. 10, l. 17), and are also provided to solve the problem of locally modifying the properties of the particulate material, as indicated on page 4, paragraph [0004] of the application. **Thus these features cannot be considered to be special technical features.**

4. The remaining features of the 3 inventions solve 3 different problems by means of different potentially special technical features and the general problem cannot be considered as constituting a single general inventive concept between the 3 inventions.

4.1 The problem to be solved by the first invention is to control the flow properties of the build material in three-dimensional printers (see the description of the application, paragraph [0197]).
The feature which solves this problem is the use of granular material with a static and dynamic friction coefficient of the granular material possessing a relationship defined by a Bredt parameter having a value in excess of 0.1.

The problem to be solved by the second invention is the sensitivity and the cost of lasers and the optical equipments needed for the production and the focusing of the laser beam in laser sintering process (see the description of the application, paragraph [0004]).
The feature which solves this problem is the use of:

- an absorber applied in accordance with a cross section of the 3D-object, absorbing spatially incoherent, polychromatic and phase-incoherent electromagnetic energy (claim 24 and dependent claims) or
- chemical sintering method (claim 34 and dependent claims) not requiring application of external energy.

The problem to be solved by the third invention is to control the application and disposal of energy in the build process (see the description of the application, paragraphs [0058] and [0115]) .
The features which solves this problem are the use of temperature control means such as a temperature controller (claim 42) or quenching agents, I. e. a first solvent having a boiling point above at least one of a sintering point and a melting point of the first particulate adhesive material (claim 43 and dependent claims).

4.2 Since the problems to be solved by the 3 inventions and the features which solve these problems are different, the different technical features cannot be considered to be corresponding special technical features as required by PCT Rule 13.2.

Therefore the present application does not comply with the requirements of PCT Rule 13.1.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: WO 2005/090055 A (DEGUSSA [DE]; MONSHEIMER SYLVIA [DE]; GREBE MAIK [DE]; GOERING RAINER) 29 September 2005 (2005-09-29)

D2: WO 2005/105412 A (DEGUSSA [DE]; BAUMANN FRANZ-ERICH [DE]; GREBE MAIK [DE]; MONSHEIMER SY) 10 November 2005 (2005-11-10) cited in the application

D3: WO 2005/011959 A (LOUGHBOROUGH UNIVERSITY ENTPR [GB]; HOPKINSON NEIL [GB]; ERASENTHIRAN) 10 February 2005 (2005-02-10)

D4: US 2004/166187 A1 (FONG JON JODY [US]) 26 August 2004 (2004-08-26)

D5: WO 97/32671 A (GUILD ASS INC [US]) 12 September 1997 (1997-09-12)

D6: US 2005/003189 A1 (BREDT JAMES F [US] ET AL) 6 January 2005 (2005-01-06) cited in the application

2. The following reasoned statement with regard to novelty, inventive step and industrial applicability takes into account clarity objections raised below, see Item VIII.

3. The above-mentioned lack of clarity notwithstanding, the subject-matter of claims 1, and 24 is not new in the sense of Article 33(2) PCT, and therefore the criteria of Article 33(1) PCT are not met.

3.1 Document D1 discloses a material system for three-dimensional printing comprising a granular material including:

- a first particulate adhesive selected from the group consisting of a thermoset material and a thermoplastic material (see p. 12, l. 26 to p. 13, l. 3); and
- an absorber capable of being heated upon exposure to electromagnetic energy sufficiently to bond the granular material (see p. 9, l. 27 to p. 10, l. 17);
- *wherein a static and a dynamic friction coefficient of the granular material possess a relationship defined by a Bredt parameter having a value in excess of 0.1 (*see

Item VIII, paragraph 2).

Therefore the subject-matter of claim 1 is not new (Article 33(2) PCT).

3.2 Document D2 discloses a process for producing a three-dimensional object, the process comprising the steps of:

a) providing a first layer of dry particulate material;

b) selectively applying at least a first absorber to a region of the first layer of the dry particulate material, wherein the region is selected in accordance with a cross section of the three-dimensional object;

c) treating the first layer with electromagnetic energy selected from the group consisting of spatially incoherent, polychromatic, and phase-incoherent, te electromagnetic energy being absorbed by the absorber to heat the treated region so as to at least one of melt and sinter the dry particulate material disposed in the region; and

d) cooling the first layer (see claim 1).

Therefore the subject-matter of claim 24 is not new (Article 33(2) PCT).

4. Dependent claims 2-23 and 25-33 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty or inventive step, the reasons being as follows:

4.1 Document D1 discloses further most of the material cited as possible options for the particulate material or the filler in dependent claims 2-23 (see p. 14, l. 9 to p. 15, l. 18). The other materials are considered to be normal options for the skilled person.

4.2 Document D2 discloses further the features of claim 25 (see claim 1).
Document D3 discloses the features of claims 28, 29 and 31.
In combination the additional features of claims 26, 27, 30, 32 and 33 are not known from the prior art. However at present the requirements of Article 33(3) PCT have formally not been met.

5. The present application does not meet the criteria of Article 33(1) PCT, because the

subject-matter of claim 42 does not involve an inventive step in the sense of Article 33(3) PCT.

5.1 The document D2 is regarded as being the closest prior art to the subject-matter of claim 42 and discloses (the references in parentheses applying to this document):
a machine for three-dimensional printing comprising:

- a printing device 3;
- a spreading mechanism 2;
- a heat source 5; and
- a temperature controller including a cooling mechanism(see p. 13, l. 7-17).

The subject-matter of claim 42 therefore differs from this known machine in that the cooling mechanism operates by flowing air over a powder surface

Therefore the subject-matter of claim 42 is new (Article 33(2) PCT).

5.2 Cooling a surface by flowing air over said surface is well known technical solution for the skilled person (see for instance document D4, claims 11, 12 and fig. 2).

Therefore the subject-matter of claim 42 is not inventive (Article 33(3) PCT).

6. The written opinion regarding claims 34-41 has to be read in combination with the objection raised in Item VIII below, paragraph 3.

6.1 Document D2 discloses a process for producing a three-dimensional object, the process comprising the steps of:

a) providing a first layer of a dry particulate material;
b) selectively applying a first fluid containing to a region of the first layer of the dry particulate material, wherein the region is selected in accordance with a cross-section of the three-dimensional object;
c) treating the first layer with electromagnetic energy so as to at least one of melt and sinter the dry particulate material disposed in the region.

The subject-matter of claim 34 therefore differs from this known process in that: the first

layer of particulate material contains a first reactive component reacting with the first fluid, wherein energy in the form of heat is released by the reaction between the first fluid and the first reactive component of the dry particulate material to at least one of melt and sinter the region of the particulate material containing the fluid, without application of electromagnetic energy.

Therefore te subject-matter of claim 34 is new (Article 33(2) PCT).

6.2 The problem to be solved by the present invention may therefore be regarded as the use of external source of energy to melt or sinter the particulate material.

6.3 The solution of claim 34 is the use of chemical sintering: energy in the form of heat is released by the reaction between the first fluid and the first reactive component of the dry particulate material to at least one of melt and sinter the region of the particulate material containing the fluid. Exothermic chemical reactions are mentioned in document D5 (see p. 40, l. 7-17). There is nevertheless no indication for the skilled person to use the energy released by a chemical reaction to melt or sinter a particulate material. Moreover as exothermic reactions are difficult to control, the skilled person would not consider this solution.

Therefore the subject-matter of claim 34 is inventive (Article 33(3) PCT).

7.1 Document D6 discloses a kit for three dimensional printing, the kit comprising:

- a fluid comprising: a first solvent,
  a second solvent (see paragraphs [0185] to [0193]);
- a first thermoplastic particulate adhesive material (see paragraph [0013]);

wherein the first solvent has a boiling point above at least one of sintering point and a melting point of the first particulate adhesive material (see paragraphs [0185] to [0193]).

The subject-matter of claim 43 therefore differs from this known kit for three dimensional printing in that the fluid further comprises an absorber.

Therefore the subject-matter of claim 43 is new (Article 33(2) PCT).

7.2 The problem to be solved by the present invention may therefore be regarded as to provide a kit for three dimensional printing usable with sources of energy different from a laser, which may be expensive and sensitive (see paragraph [0004] of the application).

7.3 The solution, according to claim 43, is that the fluid further comprises an absorber, allowing radiations from sources of energy different from a laser to be absorbed.
The use of an absorber incorporated in a fluid is known from document D2 (see claim 1). Nevertheless there is no indication for the skilled person to combine documents D6, wherein the fluid comprises two solvents with different boiling points, with D2 to come to the solution of claim 43.

T**herefore the subject-matter of claim 43 is inventive** (Article 33(3) PCT).

7.4 Claims 44-51 are dependent on claim 43 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

8. The subject-matter of claims 1-51 is susceptible of industrial application (Article 33(4) PCT).

Re Item VII
Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D3 is not mentioned in the description, nor are these documents identified therein.

Re Item VIII
Certain observations on the international application

1. Present claim 1 relates to a product defined (inter alia) by reference to the following unusual parameter:
"*a static and a dynamic friction coefficient of the granular material possess a relationship*

defined by Bredt parameter having a value in excess of 0.1."

1.1 The use of this unusual parameter, I. e. "*Bredt parameter*" in the present context is considered to lead to a lack of clarity because the claim does not clearly identify the products encompassed by it as the parameters cannot be clearly and reliably determined by indications in the description or by objective procedures which are usual in the art. This makes it impossible to compare the claim to the prior art. As a result, the application does not comply with the requirement of clarity under Article 6 PCT.

1.2 The description clearly indicates on page 54, paragraphs [0212] and [0213] that the static friction characteristics of particulate material can be measured by apparatus such as the "*Shear Scan TS12*". This kind of apparatus is nevertheless designed to measure the frictional characteristics of particulate materials in large silo and is therefore not suitable for the level of stress operating in 3D-printers.
The description indicates further in paragraph [0214] that there does not exist an analogous instrument to measure the dynamic friction characteristics of particulate material.
An "*approximate laboratory procedure*" is disclosed in paragraph [0215] to estimate the flow parameter for non-cohesive particulate build material. Nevertheless it seems difficult to implement this method based on the indication of the description only and the repeatability is questionable.

1.3 The lack of clarity and support in the description is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search of claims 1-23.

2. As a consequence of the lack of clarity of claim 1, it is considered that the applicant cannot rely on an unclear term to distinguish the claimed invention from the prior art (see the PCT Guidelines, V, 5.34).

3. Regarding claim 34, it is considered that the invention is not disclosed in a manner sufficiently clear and complete for the invention to be carried out by a person skilled in the art (Article 5 PCT). The reasons are as follows: although the description gives extensive lists of liquid carriers or binders, heat-generating materials for chemical

sintering and build materials, the description fails to disclose precise examples of combinations of materials, for which chemical sintering would work, as the thermal energy released when combined with the fluid component printed on the build material must be sufficient to melt or sinter the build material. In the case of calcium chloride, for instance, the maximum temperature reached by the exothermic reaction is around 60°C (data obtained from Wikipedia), which is below the melting point of most thermoplastic materials. Therefore it is considered that a person skilled in the art is not able to carry out the invention without "undue experimentation" (see the PCT Guidelines, V, 5.46 and 5.47).